Section 5: Sources and Loads

Photo: U.S. EPA Great Lakes National Program Office

5.1 Approach and Direction

The Sources and Loads Subcommittee is charged with the task of identifying sources and loads of pollutants identified by the Lake Erie LaMP process. The Subcommittee continues to describe the status and trends in concentrations of pollutants, identify major pollutant sources in the basin, and provide an information base upon which to support sound management decisions for reducing, removing and eliminating these pollutants from the Lake Erie system. The Subcommittee also works to identify information gaps, and recommend the information required to fill those gaps.

An initial list of chemicals selected for intensive review was identified by the beneficial use impairment assessment reports (Table 5.1). Two substances, PCBs and mercury, were designated as Lake Erie critical pollutants due to documentation that they created impairment across the basin, particularly in relation to fish and wildlife consumption advisories. As the Lake Erie LaMP progresses and specific problems and causes become better defined, additional chemicals may be designated as critical pollutants.

Table 5.1: Pollutants Causing Beneficial Use Impairments in the Lake Erie Basin

Beneficial Use Impairment	Causes of Impairment
Fish & Wildlife Consumption Restrictions	*Fish* – PCBs, mercury, lead, chlordane, and dioxins *Wildlife* – PCBs, chordane, DDE, DDT and mirex
Fish Tumors or Other Deformities	PAHs
Bird or Animal Deformities or Reproduction Problems	PCBs, other organochlorines, dieldrin, DDE, PAHs, nitrates
Degradation of Benthos	Sediments contaminated with PCBs, other organochlorines, pesticides, PAHs
Restriction on Dredging Activities	PCBs and heavy metals
Eutrophication or Undesirable Algae	Phosphorus
Recreational Water Quality Impairment	PCBs[1], PAHs[1], Exceedances of *Escherichia coli* or fecal coliform guidelines

[1]PAHs are the basis for a human contact advisory in the Black River Area of Concern (Ohio), and PCBs are the basis for a human contact advisory in the lower Ottawa River, part of the Maumee Area of Concern (Ohio). The human contact advisories were issued by the Ohio Department of Health and recommend that contact with the sediment or water in these areas be avoided.

Table 5.2: Contaminants Identified as Lake Erie LaMP Pollutants of Concern

Contaminant(s)	Common Source(s)
Organochlorine insecticides and biocides	
DDT[2,3,4,5,6,8]	Historical use on crops, microcontaminant in dicofol
• *DDD, DDE*	
Chlordane[2,4,5,8]	Historical use on crops and for termite and ant control
• *Alpha-chlordane, Gamma-chlordane, cis-nonachlor, trans-nonachlor*	
Dieldrin[2,4,5,6,8]	Historical use on crops, termite and moth control
Toxaphene[3,4,5,6,8]	Historical use on crops, topical insecticide
Mirex[3,4,5,6]	
• *Photomirex*	Historical use for fire ant control and flame retardant
Alpha-hexachlorocyclohexane	Agricultural and topical insecticides
Beta-hexachlorocyclohexane	
Delta-hexachlorocyclohexane	
Gamma-hexachlorocyclohexane	
Industrial Organochlorine compounds or byproducts	
PCBs[2,3,4,5,6,8]	Transformers, hydraulic fluids, capacitors, heat transfer fluids, inks, casting waxes
Dioxin (2,3,7,8-TCDD)[4,5,6]	Combustion byproducts, contaminant in pentachlorophenol wood preservative, other chlorophenols and derivatives, including herbicides
1,4-Dichlorobenzene[4,5]	Mothballs, household deodorants, other biocides
Pentachlorobenzene[4,5]	Chemical synthesis
1,2,3,4-Tetrachlorobenzene[4,5]	
1,2,3,5-Tetrachlorobenzene[4,5]	
Pentachlorophenol[4,5]	Chlor-alkali plants, wood preservatives
Hexachlorobenzene[4,5,8]	Byproduct of chemical manufacturing, historical wood preservative and fungicide
3,3'-Dichlorobenzidine[4,5]	Plastic manufacturing, glues and adhesives, dyes and pigments for printing inks
4,4'-Methylenebis(2-chloroaniline)[4,5]	Plastics, adhesives
Polynuclear aromatic hydrocarbons (PAHs)[4,5,8]	
Anthracene, Benz(a)anthracene Benzo(a)pyrene, Benzo(b)fluoranthene Benzo(k)fluoranthene, Benzo(g,h,i)perylene Chrysene, Fluoranthene, Phenanthrene Indeno(123-cd)pyrene	Coal, oil, gas, and coking byproducts, waste incineration, wood and tobacco smoke, and forest fires, engine exhaust, asphalt tars and tar products
Trace Metals	
Alkyl lead[4,5,6]	Leaded gasoline
Cadmium[4,5]	Batteries, pigments, metal coatings, plastics, mining, coal burning metal alloys, rubber, dye, steel production
Copper[6]	Same as cadmium, plus plumbing and wiring
Lead[6]	Same as cadmium, plus solder
Zinc[6]	Same as cadmium, plus roofing
Mercury[3,4,5,6]	Batteries, coal burning, chlor-alkali plants, paints, switches, light bulbs, dental material, medical equipment, ore refining
Tributyl Tin	Antifouling paint, mildewcide, plastic stabilizer
Current-use herbicides[7]	
Atrazine, Cyanazine, Alachlor, Metolachlor	Agricultural herbicides
Other Contaminants	
Total phosphorus, Nitrate-nitrogen	Fertilizers and sewage
Fecal Coliform, *Escherichia coli*	Sewage and animal waste
Total suspended sediments	Soil erosion

[1]Contaminants indented are degradation products; those shown in italics have been identified as chemicals of concern
[2] Lake Erie Chemicals of Concern identified by Lake Erie LaMP in 1994
[3]Great Lakes Initiative Bioaccumulative Chemical of Concern (BCC)
[4]COA-Tier1 or Tier 2 contaminant
[5]Binational Toxic Strategy contaminant
[6]Contaminant identified by the IJC or in Remedial Action Plans
[7]U.S. EPA
[8]Canadian Toxic Substance Management Policy – Track 1

The Sources and Loads Subcommittee also compiled a second, more comprehensive list of pollutants and their degradation products designated by a variety of agency programs as being pollutants of concern within the Lake Erie basin (Table 5.2). This expanded list formed the basis for evaluation of information on all the pollutants of concern in Lake Erie to determine the suitability of the data for estimating loads and whether there are ongoing sources or pathways of contamination to the Lake Erie ecosystem.

In 2000, the Subcommittee provided an overview of the results of the *Characterization of Data and Data Collection Programs for Assessing Pollutants of Concern in Lake Erie* (Painter et al., 2000) to the LaMP. Briefly, this study characterized the information available from both the U.S. and Canadian public sectors and research laboratories in digital databases, and assessed the suitability of these data for identifying sources and characterizing pollutant concentrations and loadings to Lake Erie.

In general, data for nutrients (phosphorus and nitrate-nitrogen), suspended sediment and atrazine (an in-use pesticide) were considered likely to be adequate for characterizing tributary and point source concentrations and loads to the lake. However, for the organochlorine compounds, PAHs and trace metals, the majority of the databases were considered to contain data of insufficient quality and quantity or to be not applicable to characterize tributary, lake, or point source concentrations or annual loads to Lake Erie within acceptable levels of uncertainty. The insufficiencies were due to a number of factors, including the past use of methods that do not meet current quality assurance and quality control specifications for sampling in the part per billion and part per trillion concentration ranges, at which many of these compounds are now known to persist in the environment.

Concentration data for aquatic bed sediments and fish tissue were determined to be less susceptible to the limitations of quality and quantity than the organochlorine, PAH and trace metal data reported for surface water. Although not suitable for computing loads, these data could provide a strong indication of the extent and severity of contamination in the Lake Erie basin, and could be used to help indicate important source areas.

The findings and recommendations made in the report have helped to guide the activities of the Subcommittee since that time. Because a binational commitment to virtually eliminate sources of persistent toxic substances has already been made, and given the relative inadequacy of existing data to compute loads for these pollutants, it was determined to be more productive to pursue methods other than the calculation of loadings to identify the major sources and pathways of critical pollutants in Lake Erie.

5.2 Integration of Basin-Wide Sediment Quality Data, 1990 – 2001 (U.S. and Canada)

The Sources and Loads Subcommittee is integrating available information from many jurisdictions in both the United States and Canada about the pollutants of concern and the Lake Erie critical pollutants. Ambient environmental information including sediment quality data, tissue residue levels in aquatic biota and other information sources, are being compiled into the Lake Erie Information Management System (LIMS) together with information about potential contaminant sources such as municipal and industrial discharge data. The integration of information is facilitating management discussions on possible sources of these pollutants in the Lake Erie basin.

As a priority activity, the Sources and Loads Subcommittee has integrated sediment quality data on a binational basis. Sediments are an appropriate medium for contaminant analysis, since many of the contaminants of concern preferentially adsorb to sediment. In addition, a great deal of sediment quality data already exists across the basin. As primary depositional material, sediments not only implicate potential sources of contamination, but they also are the substrate by which food web uptake begins. In the near future, the LaMP Sources and Loads Subcommittee will perform comparisons between contaminants found in sediments and those found in fish tissue.

Integration of the available information identified data gaps, and several studies were initiated to ensure a more comprehensive information base. For example, when recent information on the spatial distribution of open lake sediment pollutant concentrations was

required for the project described above, Environment Canada and Ohio EPA collaborated on a study that provided open lake pollutant concentrations in surficial sediments for many historical and emerging chemicals of concern. The 1997/98 survey conducted by Environment Canada and Ohio EPA not only provided valuable information on the open lake spatial distribution of contaminants, but because an earlier 1971 Environment Canada survey had been conducted, a retrospective analysis of the trends over time was also possible (Painter et al. 2001). Encouragingly, PCB concentrations have declined lakewide. Concentrations are one third of what they were 30 years ago. Mercury concentrations have also similarly declined.

The sediment distribution of the two LaMP critical pollutants, PCBs and mercury, as shown in Figures 5.1 and 5.2, were originally presented in the 2002 LaMP report. These figures represent an evaluation of PCBs and mercury in bed-sediments as compared to predetermined aquatic biological effect levels called threshold effect levels (TEL) and probable effect levels (PEL) after Smith, et al. (1996).

Dioxin concentrations in surficial sediments of Lake Erie were unavailable prior to the study conducted by Environment Canada and Ohio EPA. The Canadian probable effect level (21.5 pg/g TEQ) (CCME, 1999) was exceeded at 40% of the sites, all in the western and south-central basins of the lake (Figure 5.3).

In addition, information was collected on the following pollutants: chlordane, a former-use pesticide typically used for controlling insects in the home; polynuclear aromatic hydrocarbons (PAHs), a complex series of compounds resulting from the incomplete combustion of fossil fuels such as coal, gasoline, fuel oils, and tar, but also from the combustion of wood; and lead, having historical uses in gasoline and now found in oil and coal combustion, metal refining and fabrication, and waste incineration. Concentrations of these pollutants are presented in Figures 5.4 to 5.6 as compared to biological effect levels described by Ingersoll et al. (2000) and MacDonald et al. (2000), represented as Threshold Effect Concentrations (TEC) and Probable Effect Concentrations (PEC).

Chlordane is found above the PEC (17.6 µg/kg) in and downstream of all major urban areas in the drainage area. This apparently has a slight impact on the western basin and south shore of Lake Erie, where exceedences of the TEC (3.24 µg/kg) are observed regularly. Less frequent are the occurrences of elevated chlordane above the PEC and TEC in bed-sediments along the north shore of Lake Erie (Figure 5.4).

Similar to chlordane, total PAHs (the sum of individual PAH compounds) are also found above the PEC (22,800 µg/kg) in and around all major urban centers within the drainage area. However, total PAHs are also found at concentrations exceeding the PEC in smaller urban areas, owing to the widespread abundance and persistence of PAH compounds in the environment. As expected, some of the highest concentrations (greater than 10 and 100 times the PEC) are found in heavily industrialized centers, but a few highly contaminated areas are isolated from major urban centers (Figure 5.5). These point-source signatures are manifest in the open lake environment, where concentrations exceeding the TEC (1,610 µg/kg) are found frequently in the western basin, the central basin and along the entire south shore. Fewer exceedences of the TEC are observed along the north shore of Lake Erie.

Similarly to chlordane and total PAHs, lead is found above the PEC (128 mg/kg) primarily in urban and industrial areas, and its distribution in the open lake basins is greater in the west compared to the east (Figure 5.6). Concentrations along both the south and north shores exceed the TEC (35.8 mg/kg), but exceedences are found more frequently along the south shore.

Figure 5.1: Total PCBs in bed sediments

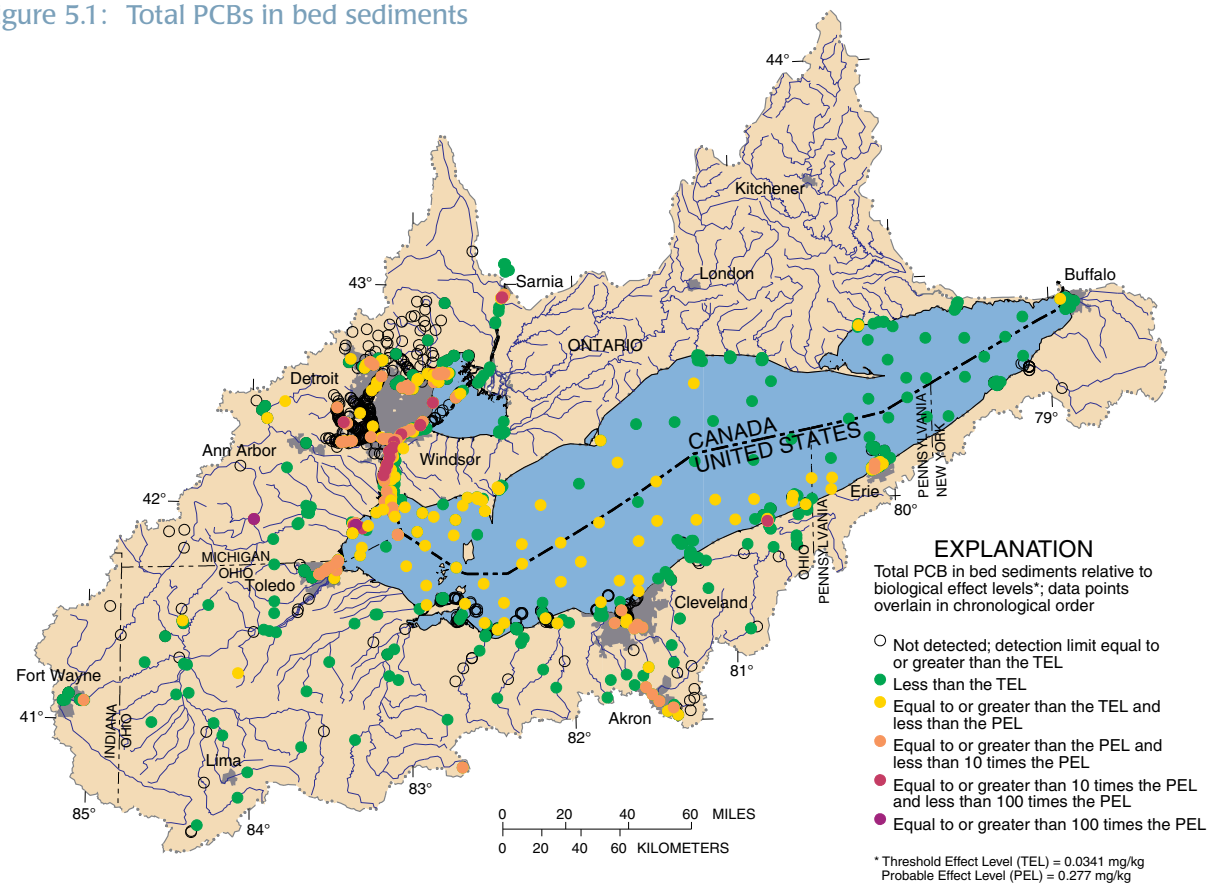


Figure 5.2: Total mercury in bed sediments

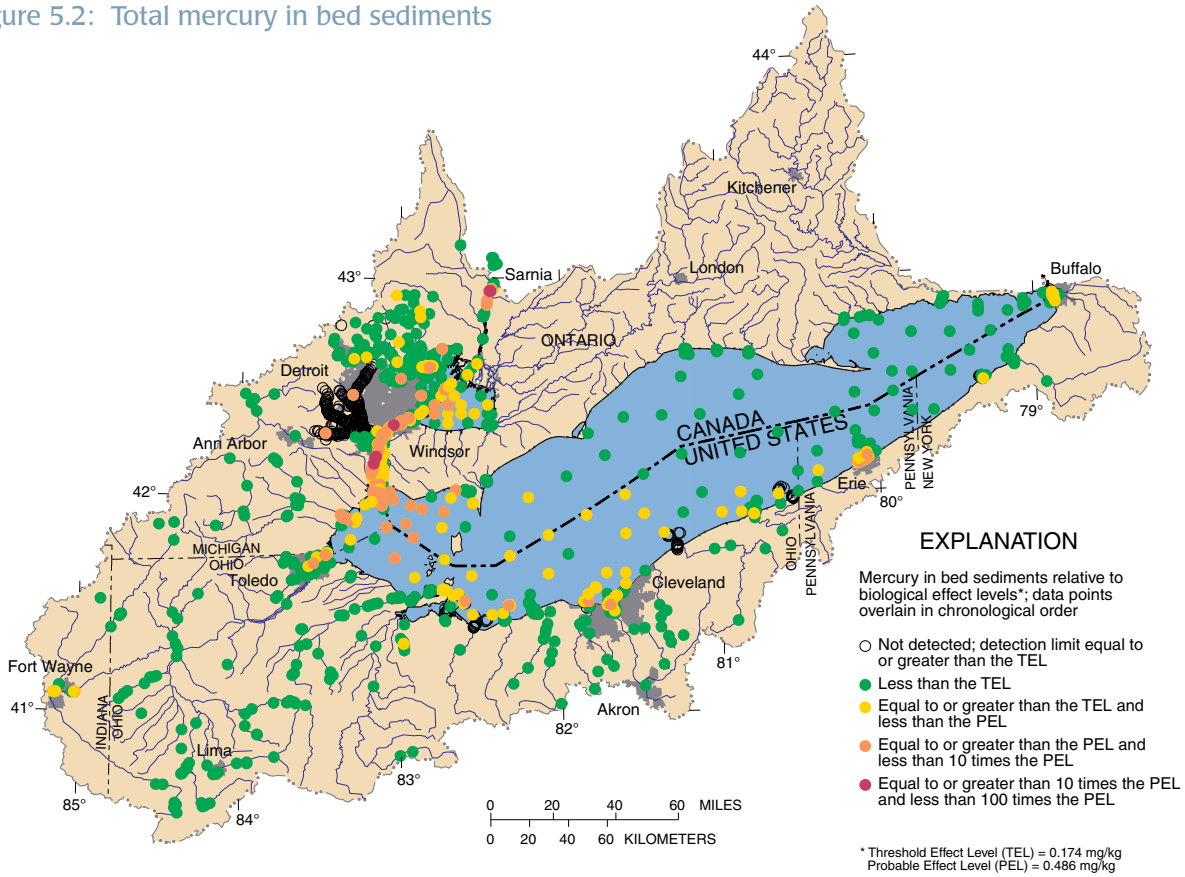


Figure 5.3: Surficial sediment concentration of dioxin (pg/g TEQ)

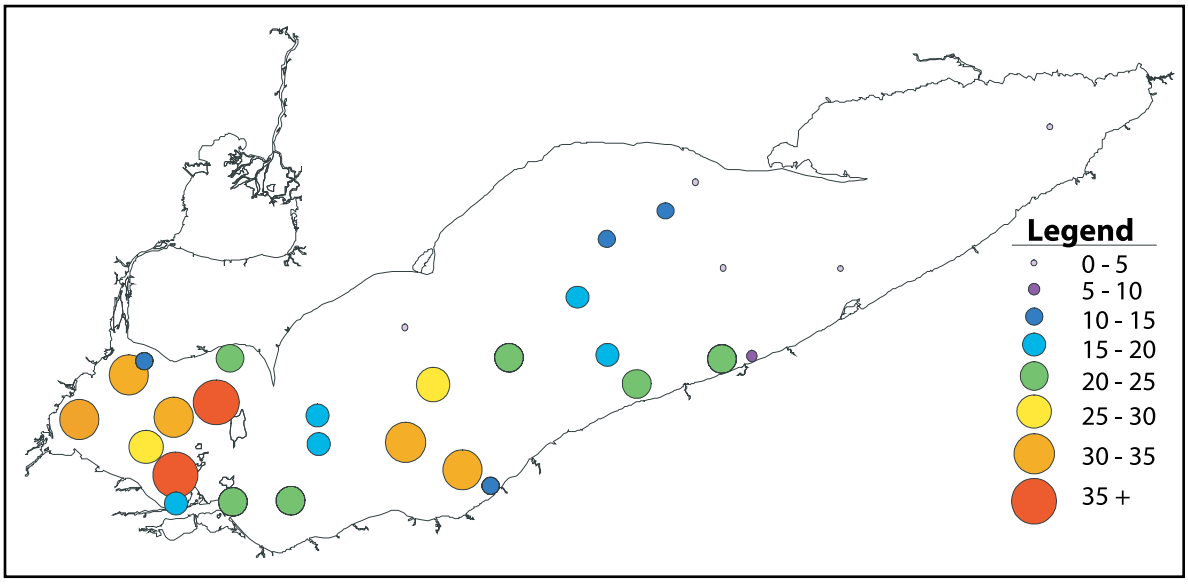


Figure 5.4: Total chlordane in bed sediments of the Lake Erie - Lake St. Clair basin, 1990-2002

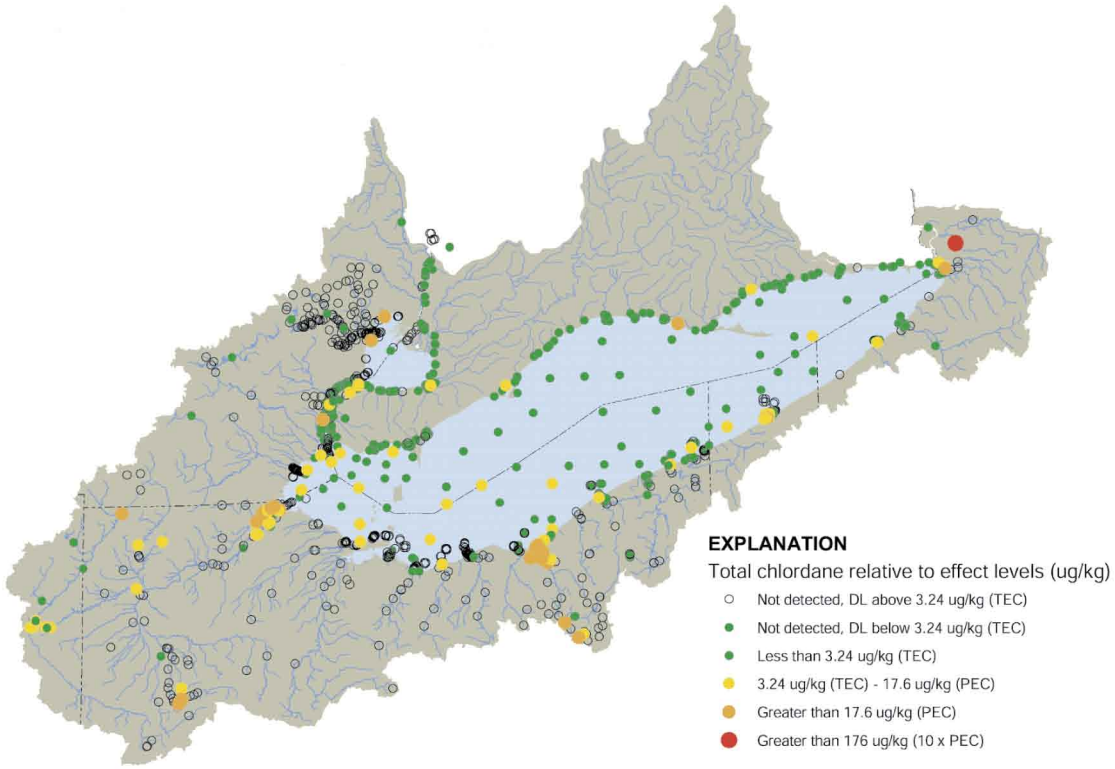


Figure 5.5: Total PAHs in bed sediments of the Lake Erie - Lake St. Clair basin, 1990-2002

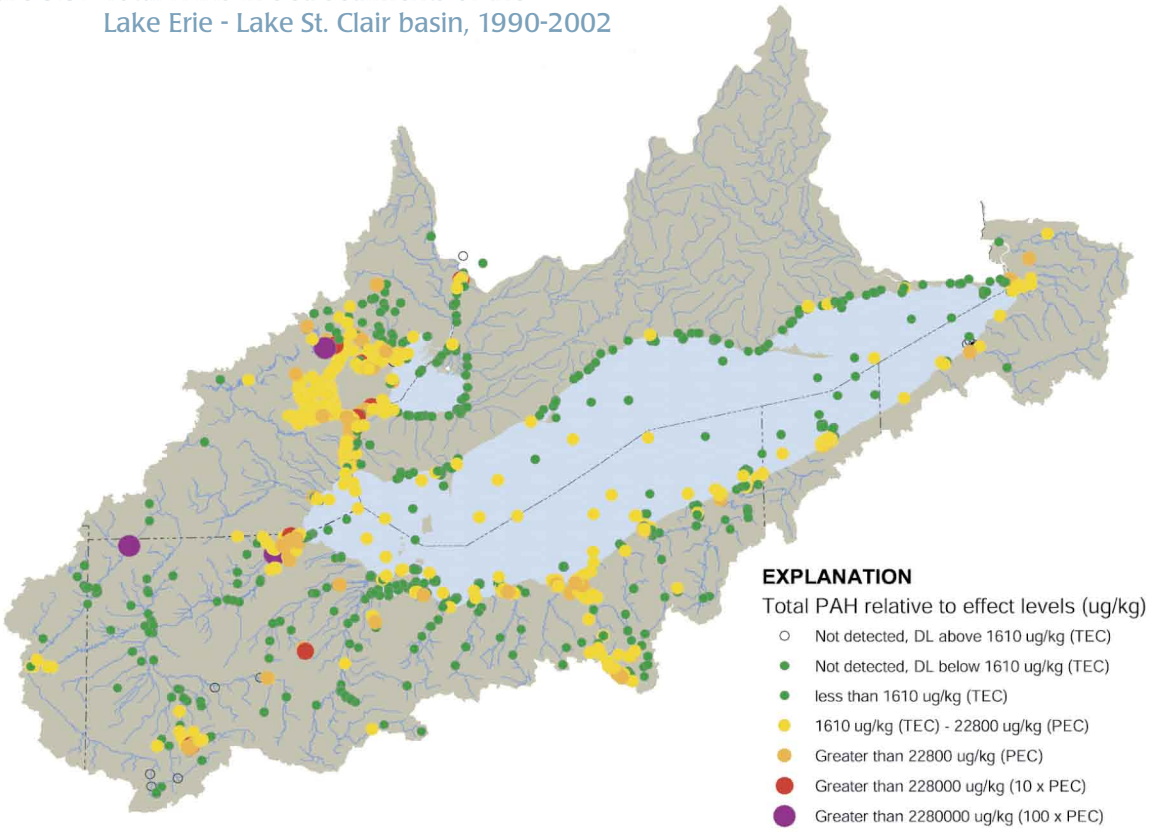
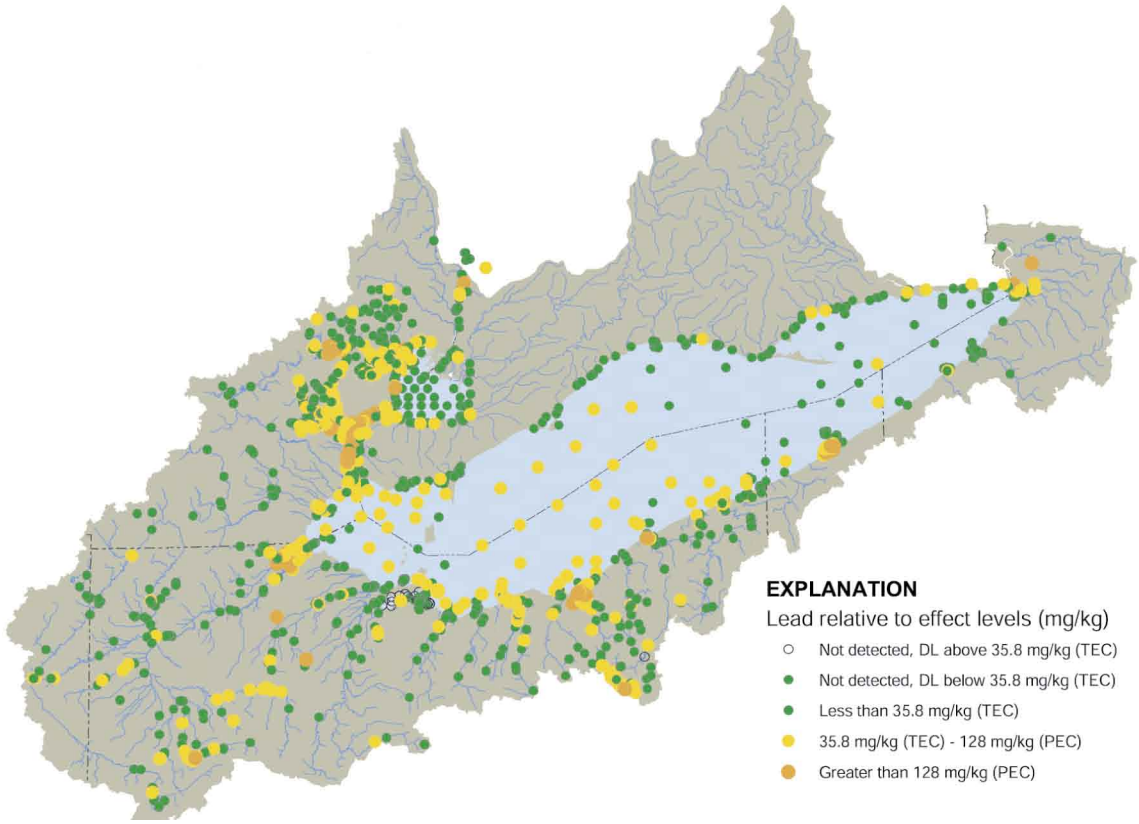


Figure 5.6: Lead in bed sediments of the Lake Erie - Lake St. Clair basin, 1990-2002



SMART (Sediment Management, Assessment and Remediation Team)

In an effort to organize the basin-wide assessment for the management and reduction of contaminated sediments, the Lake Erie LaMP Sources and Loads Subcommittee sponsored a meeting that convened in Presque Isle Bay State Park, Pennsylvania, in the summer of 2002. Representatives were from both Canada and the United States with national, state, and local interests. They included Environment Canada, Ontario Ministry of Environment, U.S. Environmental Protection Agency, U.S. Geological Survey, Michigan Department of Environmental Quality, Ohio Environmental Protection Agency, and Pennsylvania Department of Environmental Protection.

The opportunities for using a basin-wide sediment database from multiple sources mapped in a geographic information system (GIS) seem endless, however much of the discussion revolved around addressing a number of topics: 1) the completeness of the database, 2) the spatial distribution of different contaminants, 3) identifying key areas of the basin with apparent multiple contaminant issues, 4) determining if there are needs for new or additional monitoring, and 5) determining if there any known contaminated areas that are not being addressed at this time.

Key points made during the workshop with regards to management of contaminated sediments were that:

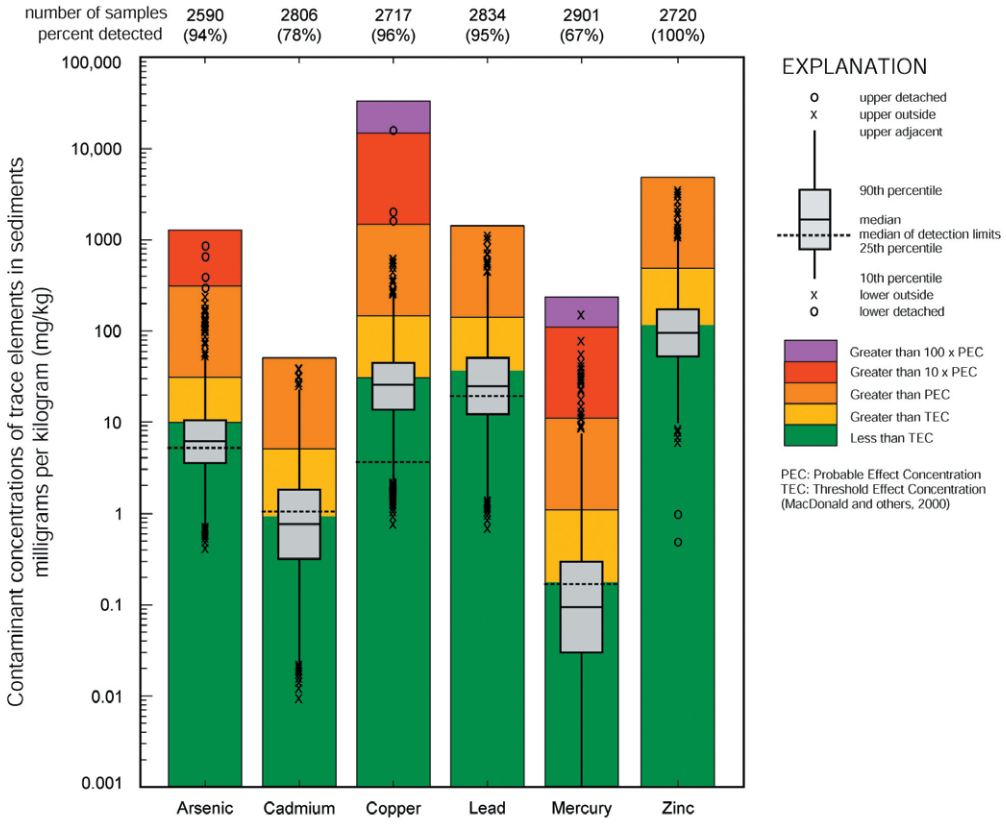
- Certain agencies have the programs and funding to clean up contaminated sediments, but lack an approved location to dispose of the sediments.
- The contamination quality typically left behind after dredging projects may still represent some of the most contaminated sites remaining in the basin. Sediment remediation efforts typically focus on highly contaminated hot-spots in well-defined zones, whereas sediment contamination in excess of biological sediment quality guidelines may be wide-spread. Moreover, criteria for sediment remediation (i.e., cleanup levels) are not as stringent as some sediment quality guidelines. To clean up to more stringent guidelines would be cost prohibitive, in many cases. However, the divergence between sediment cleanup guidelines and desired sediment quality must be addressed if we are to attain sediment quality that sets guidelines at contaminated sites in the Lake Erie basin.
- The apparent decreasing west to east gradient for many parameters in the open lake indicates that sources are primarily point sources into the system and not principally the result of atmospheric deposition.
- Controlling contaminant movement is not simple. Historically deposited contaminated sediments may be re-suspended and move downstream during storm events or may be disturbed by shipping activities.
- As point sources are identified and controlled, the role of non-point sources may become more important. Non-point sources such as contaminated soils and leaky landfills will be difficult to track, and their identification and control may represent a major challenge to further improvements in the open lake contaminant status.

5.2.1 Statistical Summaries of Contaminants in Bed Sediments

Concentrations of selected contaminants in bed sediments are summarized in Figures 5.7 to 5.9. The samples were collected during 1990 to 2003. These box plots represent both a statistical summary of the range of detected concentrations, as well as extrapolations of the non-detected samples (using the Adjusted Maximum Likelihood Estimator (AMLE) method for the interpretation of multiple samples with no detections, Helsel and Hirsch, 1993). The selected contaminants are depicted on a logarithmic scale relative to established biological effect levels: Threshold Effect Concentration (TEC) and Probable Effect Concentration (PEC), as developed by MacDonald et al. (2000). TEC and PEC values do not exist for mirex and hexachlorobenzene (HCB). Lowest Effect Levels (LEL) and Severe Effect Levels (SEL) (Persaud et al. 1993) were used instead.

Figure 5.7 shows a statistical summary of selected trace elements from the Lake Erie LaMP Pollutants of Concern Table 5.2, as well as arsenic. In each and every case, the median concentrations (50% of the results) are found to be below the TEC. This supports the understanding that high levels of trace element contamination are not systemic throughout

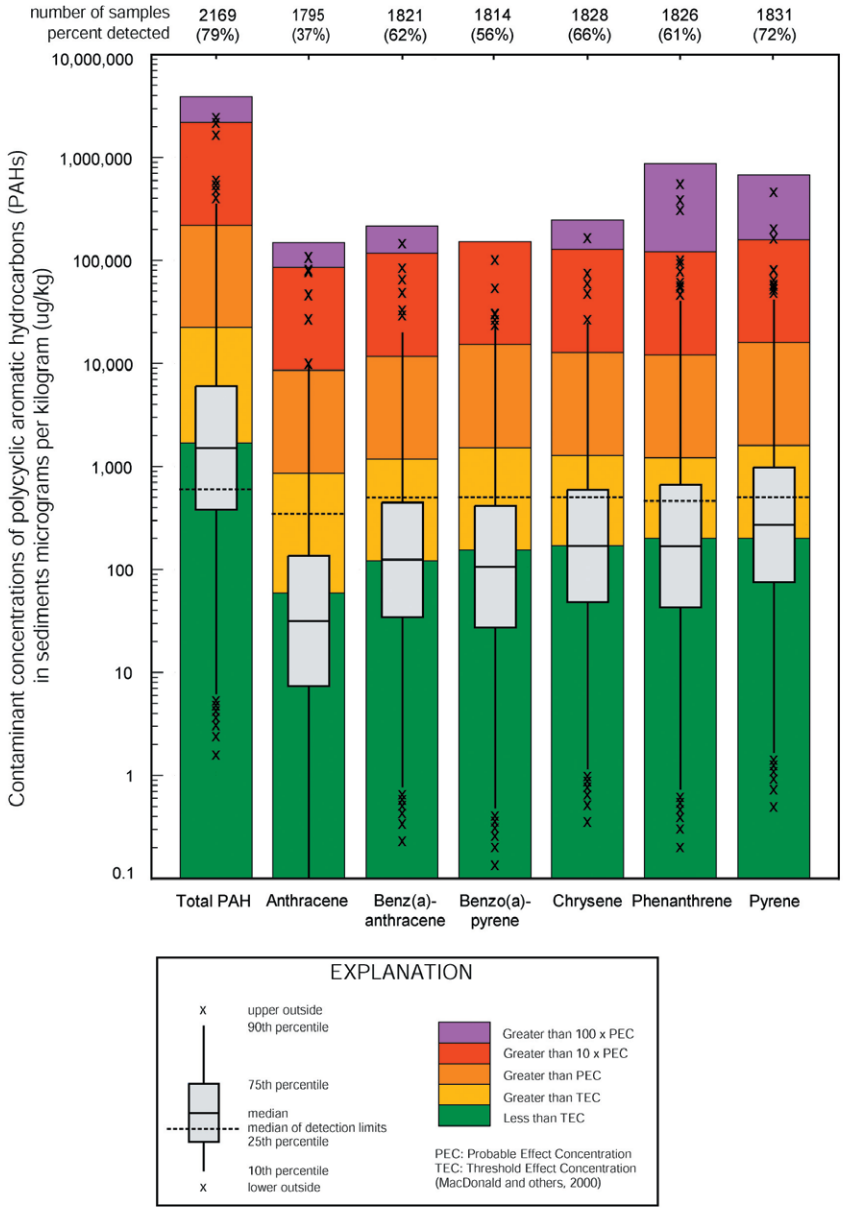
Figure 5.7: Summary statistics shown in boxplot format for trace element contaminants in bed sediments of the Lake Erie Basin, relative to biological effect levels. Data compiled from various provincial, state, local and federal agencies, 1990-2003.



the basin in either the tributaries or the open lake, but rather co-located with source areas such as urban-industrialized areas. Furthermore, for each contaminant, the top 25 percent of the sample results extend above the TEC, and the top 10 percent of each contaminant extends above the PEC. Percent detections range from 67 percent for mercury to 100 percent for zinc. Arsenic, copper and mercury all showed concentrations exceeding 10 times the PEC at discrete locations within the basin, while only copper and mercury were found to be exceeding the PEC by 100 times each at one location. The highest concentrations of trace elements, those exceeding the PEC, were found to be associated with, or downstream of, urban-industrialized areas such as: Buffalo, NY; Erie, PA; Cleveland, Akron, Lorain, Toledo, and Lima, OH; Monroe, Detroit, and Pontiac, MI; and Windsor and Sarnia, ON. For those samples with no detections, the median of detection limits were, for all contaminants except cadmium, at or below the TEC.

Total PAH represents either a lab measure result or a database calculated result of U.S.EPA's 16 most commonly measured PAHs. A statistical summary of total PAH and selected individual PAH compounds is shown in a series of boxplots represented in Figure 5.8. Frequency of detection ranged from 37 percent for anthracene to 79 percent for total PAH. More than half of the samples for anthracene, benzo(a)pyrene, chrysene, phenanthrene, and total PAH were found to be below the TEC, but for benz(a)anthracene and pyrene, more than half the samples were found to be above the TEC. Each contaminant and total PAH had greater than 25 percent of the results above the TEC, and the top ten percent of the samples were found to be above levels ten times greater than the PEC. All contaminants had at least one sample concentration exceeding 100 times the PEC, except for benzo(a)pyrene. Overall, individual PAH contaminants showed relatively the same statistical distribution pattern, while concentrations of total PAH were found to be at least one order of magnitude above individual contaminants. Both findings support the fact that multiple contaminants of PAHs are usually found together when a given source is present. Much like trace elements, the

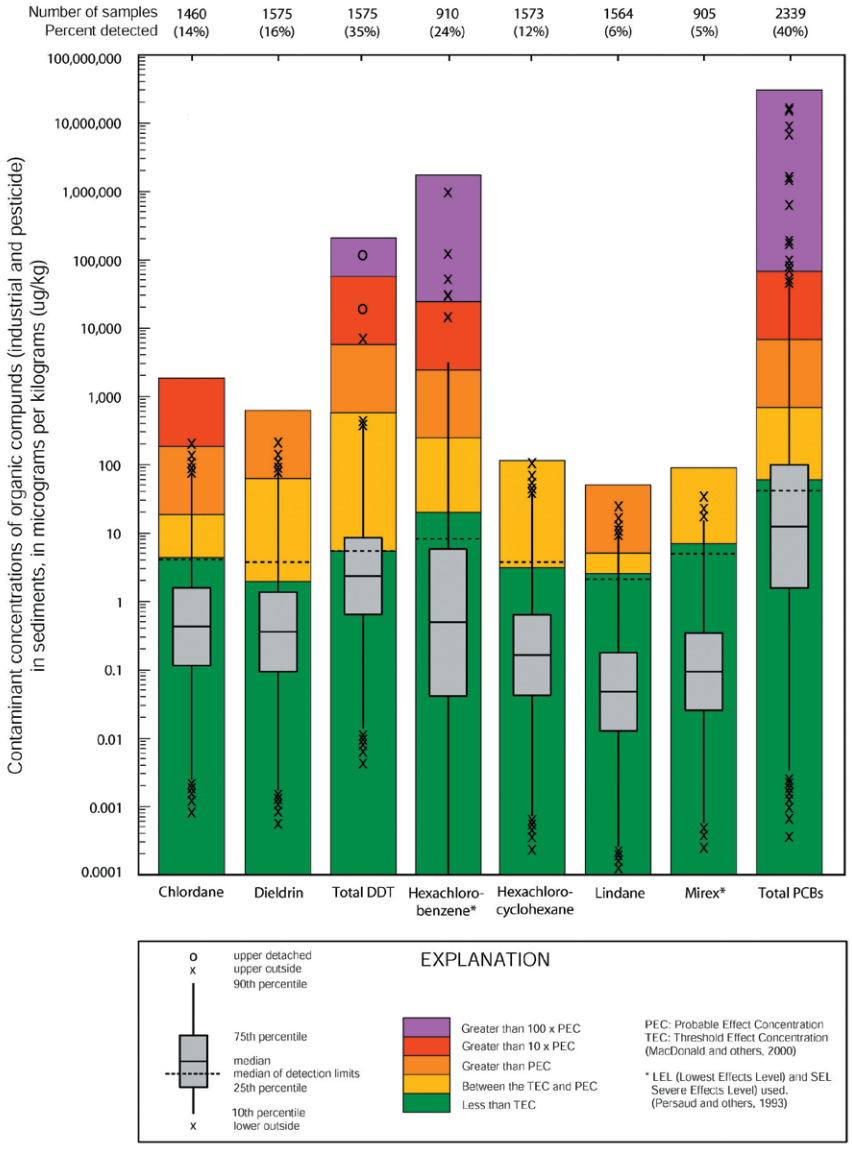
Figure 5.8: Summary statistics shown in boxplot format for PAH contaminants in bed sediments of the Lake Erie Basin, relative to biological effect levels. Data compiled from various provincial, state, local and federal agencies, 1990-2003.



high concentrations of PAH compounds were found to be near or downstream of urban-industrialized areas such as: Akron, Cleveland, Lorain, and Toledo, OH; Detroit and Pontiac, MI; and Sarnia, ON. However, high amounts of PAH contaminants in streams and inland lake sediments were also seen in rural communities in northwest Ohio where concentrations have been linked to creosote production and petroleum processing and refining.

Despite being banned from production almost 30 years ago, various manmade organochlorine contaminants are still persistent in the environment. They are still detected in bed sediments, and continue to bioaccumulate up through the food web. Figure 5.9 shows the statistical distribution of various organochlorine pesticides (DDT, dieldrin, mirex, lindane, chlordane, hexachlorocyclohexane, hexachlorobenzene) along with total PCBs, that were sampled from 1990 to 2003. The range of detected concentrations for the organochlorines is quite large, extending over 12 orders of magnitude from the lowest detection limit to the highest measured concentrations of total PCBs. Frequency of detection for organochlorine compounds was generally much lower than detections of trace elements or PAHs. Detection

Figure 5.9: Summary statistics shown in boxplot format for industrial and pesticide contaminants in bed sediments of the Lake Erie Basin, relative to biological effect levels. Data compiled from various provincial, state, local and federal agencies, 1990-2003.



frequencies for pesticides ranged from 35 percent for DDT to 5 percent for mirex. PCBs were detected 40 percent of the time.

Given the lower frequency of detection and the integration of the non-detections into the summary statistics, it is encouraging to see that the median concentration of organic compounds never exceeded the TEC or LEL. Moreover, only DDT and PCBs had greater than 25 percent of the samples above the TEC. Chlordane, dieldrin, and lindane (HCB-g) all had greater than 10 percent of their results above the PEC, while more than 10 percent of the samples from hexachlorobenzene (HCB-a,b,d,g) and total PCBs extended above 10 times the PEC. Individual samples of DDTs, hexachlorobenzene and total PCBs were found to be greater than 100 times the PEC.

The highest concentrations of organochlorine pesticides in stream and lake-bed sediments follow a pattern indicative of their historic use in residential, industrial and agricultural settings, and were found near or downstream of: Buffalo, NY; Erie, PA; Cleveland, Lorain, Lima, and Defiance, OH; Dundee, Monroe, and Detroit, MI; and Sarnia, ON. In all the organochlorine compounds, the median of the detection limits extended above the median

measured concentration, and in the case of dieldrin and hexacholorcyclohexane, the median of the detection limits extended above the TEC or LEL. For all contaminants, when detection limits extend above the lower biological effects levels (TEC or LEL) they become too great to help with any interpretation of the sediments' effects on biological susceptibility.

A detailed summary of the bed sediment data analyzed for use in the LaMP 2006 Report, along with related fish tissue and source data, will be published by USGS in 2007.

5.3 Screening-Level Survey of Tributaries to the Lower Great Lakes (Canada)

Environment Canada, Ontario Region, has conducted a screening-level survey of sediment quality in tributaries to the lower Great Lakes. In 2001, approximately 100 Canadian tributaries to the St. Clair River, Lake St. Clair, the Detroit River and Lake Erie were sampled. Since that time, follow-up investigations have been conducted in selected Lake Erie watersheds. Virtually every tributary draining Ontario watersheds to the lower Great Lakes and their interconnecting channels are being sampled in this program.

To achieve the program objectives, a single, composite sediment sample is obtained from each tributary in a manner that maximizes the probability of detecting contaminants, if they exist, at the site. The targeted substances are relatively insoluble in water (i.e., hydrophobic) and, if present, are typically found at higher concentrations in sediments than in water. The sampling protocol is based upon the *Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants*, developed by the United States Geological Survey (USGS) for the U.S. National Water-Quality Assessment Program (NAWQA) (Shelton and Capel 1994). In the NAWQA program, downstream locations in watersheds are selected to provide a coarse-scale network of sites. At these integrator sites, large-scale problems that may not be detected in smaller basins have a reasonable chance of being detected.

The sediment samples are submitted for analysis of organochlorine compounds, PAHs, metals, total organic carbon and particle size distribution. Selected samples are also being screened for additional parameters such as dioxins and furans, polychlorinated napthalenes, polybrominated diphenyl ethers, in-use pesticides and other parameters of emerging concern, as resources permit.

The results of these surveys provide information about recently deposited sediment quality, and can be used to help identify if Canadian watersheds are sources of pollutants to the Great Lakes. The results are also used to prioritize sites for any subsequent follow-up work. An internal Environment Canada data report entitled *Sediment Quality in Canadian Lake Erie Tributaries – A Screening Level Survey* (Dove et al., 2002) has been shared with other environmental agencies, and confirmatory and/or follow-up work has already been initiated at all tributaries in the Lake Erie basin that showed elevated concentrations of either of the two Lake Erie critical pollutants, PCBs and mercury.

Photo: Environment Canada

5.4 Source Track-Down Project (Canada)

As part of a commitment to virtually eliminate the releases of persistent, bioaccumulative and toxic substances to the Great Lakes, the Ontario Ministry of the Environment (MOE) and Environment Canada (EC) have partnered to track down possible active sources of PCBs in Great Lakes watersheds. To date, three pilot projects have been undertaken in the Lake Ontario basin. Several objectives were intended for these pilot projects that are of interest to the Lake Erie LaMP:

1. To determine if such track-down projects are effective means of reducing local sources of PCBs;
2. To assess the effectiveness of various investigative tools;
3. To develop appropriate project design and methodologies, and;
4. To develop a guidance framework for future track-down projects.

The project partners have been working on developing the tools to help guide the selection, initiation and conduct of future track-down projects. It is anticipated that similar track-down projects will be initiated in Lake Erie. The initial focus will be to track down sources to tributaries that result in exceedences of environmental criteria near the point of discharge to Lake Erie. Projects would be initiated on a priority basis, with consideration of all available information to determine whether a track-down project would be warranted at a particular site.

5.5 Mercury and PCB Reduction Initiatives

The Great Lakes Binational Toxics Strategy (GLBTS) is the principle mechanism used by the LaMP to address pollution prevention and reduction initiatives for LaMP identified critical pollutants. Specifically, the GLBTS seeks to achieve reductions of use and/or release of various persistent bioaccumulative toxic substances, including mercury and PCBs, through voluntary agreements, projects and information sharing about cost-effective reduction opportunities for state, provincial and local governments, industry, and non-government organizations. This report provides a very brief overview of mercury and PCB activities. The GLBTS 2003 Progress Report (available online at www.binational.net) provides more detailed information.

National and International Activities

As with all the Great Lakes, Lake Erie receives deposition of airborne toxics from both distant and local sources. National and international programs have an important role in protecting Lake Erie from inputs of critical pollutants by reducing releases both within the basin and, in the case of pollutants that are atmospherically transported long distances, into the basin.

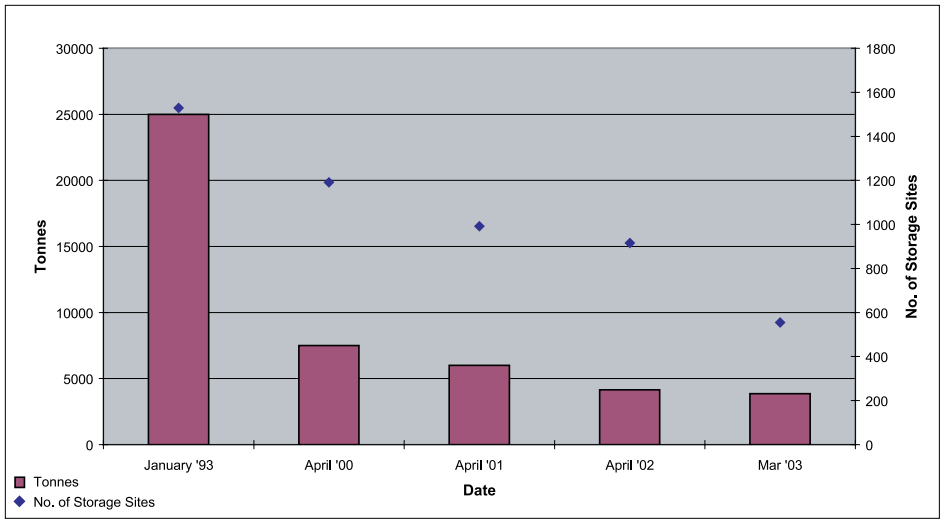
The United States and Canada have both signed the Stockholm convention on Persistent Organic Pollutants, which restricts the global production and use of twelve chemicals, including PCBs, dioxin, toxaphene, dieldrin, DDT, chlordane, and hexachlorobenzene (HCB). Canada has ratified this treaty and, in the United States the Senate Public Works and Environment Committee has recommended ratification. In addition, both nations are participating in the Mercury Programme of the United Nations Environment Programme, which has urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases of mercury.

At the national level, both countries have implemented actions to reduce air emissions of mercury, PCB, and other contaminants.

PCB Reduction Progress

The long-range transport of PCBs is a significant portion of the loadings experienced within the Lake Erie Basin. While the GLBTS 2003 Progress Report doesn't break out progress specific to the Lake Erie Basin, the report provides the broader context for loading reductions for Lake Erie.

Figure 5.10: High level PCBs and number of storage sites in Ontario



As of March 2003, approximately 85 percent of high-level PCB wastes in Canada had been destroyed, up from approximately 40 percent in spring 1998 when work in support of the GLBTS commenced. From April 2001 to March 2003, approximately 1,300 tonnes of high-level PCBs were destroyed (Figure 5.10), and as of April 2003, approximately 983 storage sites (both federal and private) were PCB-free (no PCBs in use or in storage), with about 555 sites still remaining.

Rates of PCB phase-out have declined in recent years because remaining PCB equipment is difficult or expensive to replace and the fate of the Canadian PCB incinerator in Swan Hills, Alberta, is uncertain. However, the Canadian government is planning to regulate PCB phase-out dates (see Table 5.3 for proposed PCB regulations). Awareness among owners continues to increase due to continuing PCB outreach, the PCB Phase-Out Awards Program (Canada), sector mail-out of information, and voluntary commitment letters. Newer facilities and options are now available in Ontario for PCB decontamination and destruction, in addition to the Alberta Swan Hills incinerator. Owners of large quantities of PCBs have been able to incorporate PCB phase-out and destruction activities into multi-year operating plans, but smaller businesses have difficulty absorbing a large capital expense in any one fiscal year.

The priority sectors in Ontario that still have a considerable amount of high-level PCBs in use include: iron/steel, governments, and mining/smelting. In addition, schools, care facilities, and food processing are priority sectors as sensitive areas that still have high-level PCBs in use. These sectors need to be targeted for PCB decommissioning. Sectors in Ontario that need to be targeted for destruction of high-level PCBs in storage include the provincial and municipal governments, iron & steel production, and the forestry/pulp and paper industry.

According to annual reports submitted to U.S. EPA, the estimated amount of PCB transformers and capacitors remaining in the U.S. at the beginning of 2001 is less than 129,000 PCB transformers and less than 1,332,000 PCB capacitors. The reports do not include PCB transformers that have been reclassified or some capacitors that may be on the reports under the category of PCB article containers. The 1999 PCB Transformer Registration Database shows that there are approximately 20,000 PCB transformers currently registered and in-use in the U.S., but the actual number remaining in use is likely higher. Nonetheless, reductions of PCB transformers and capacitors continue to occur. U.S. EPA continues to evaluate ways to try to better quantify the data and help track progress toward meeting the U.S. challenge.

Current Focus of PCB Reduction Efforts

The GLBTS PCB Workgroup plans to continue its core activities, including the following:

PCB Reduction Commitments:

The Workgroup will continue seeking commitments to reduce PCBs through PCB reduction commitment letters and other PCB phase-out efforts.

Outreach/Sharing Information:

The Workgroup will continue to develop, distribute, and post on the Workgroup website, information which can facilitate and promote, as applicable, the identification and removal of PCB equipment. These include: photographs of electrical equipment; fact sheets; case studies that identify reasons companies remove PCBs; and a standard presentation of the PCB Workgroup's challenges and activities. The Workgroup will also continue to consider incentives for removing PCB equipment.

ISO 14000 and PCBs:

The PCB Workgroup has decided to lobby the ISO (International Standards Organization) to include PCBs as a specific hazardous material to be managed and eliminated. If the ISO were to include PCBs as a targeted substance, it would encourage applicants for ISO status to plan for the elimination of their PCBs.

Property and Liability Insurance and PCBs:

After questions and discussion at the May 2003 GLBTS Stakeholder Forum, the PCB Workgroup decided to investigate ways that insurance companies handle PCBs as an insurance risk. If insurance companies see PCBs as an "additional risk" above and beyond other hazardous substances, then it would be an advantage to PCB owners to eliminate their PCBs and reduce their risk ratings. U.S. EPA is looking into the potential for insurance to be used as an incentive for companies to remove PCBs.

Photo: U.S. EPA Great Lakes National Program Office

Table 5.3: PCB Reduction Plan Activities Update 2004

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
Pollution Reduction		
Work with automotive, iron and steel sector and electrical facilities in the Lake Erie basin to establish voluntary commitments to reduce the use, discharge or emissions of PCBs.	**Canada:** (reductions noted below occurred in whole or in part in the Lake Erie Basin) ***Steel Sector:*** • Stelco achieved a 91 percent reduction of PCBs in storage and 41 percent reduction of in PCBs in service; • The steel sector continues to work toward a solution to the large amount of PCBs in use transformers and capacitors. ***Automotive:*** • The Canadian automotive industry destroyed 4,359 kgs and 133,495 litres of high-level PCBs across Ontario; • Daimler-Chrysler, Canada, removed all high-level PCBs from transformers and capacitors and sent them to the Swan Hills PCB-incineration facility for destruction. ***Utilities:*** • 42 electrical utilities submitted voluntary commitment letters to Environment Canada; • A number of small- to medium-sized utilities in Ontario achieved 90 percent or better high-level PCB reduction targets; • Hydro One has eliminated all high-level PCBs in its network; • Canadian Niagara Power has eliminated all high-level PCBs from its Niagara area network; • Festival Hydro (Stratford, Ont.) has eliminated all high-level PCBs; ***Others:*** • Canadian Petroleum Producers Association and its members eliminated 90 percent of PCBs; • City of Windsor and Essex County sent 65,000 kgs of PCB-contaminated materials to Swan Hills for destruction; • Public Works and Government Services Canada has implemented an aggressive PCB phase-out program and has eliminated over 90 percent of their PCBs across Ontario; • Conestoga College and Wilfrid Laurier University have eliminated all high-level PCBs from their inventories; • The Thames Valley District School Board, Coca-Cola (Chatham), and Frito Lay (Cambridge) are all PCB-free. **U.S.:** U.S. EPA began to finalize information for the nation wide outreach campaign on phasing out PCB equipment and investigated the use of a hotline number as the point of contact. In addition, in 2003, U.S. EPA funded an expansion of the outreach and PCB phase-out solicitation campaign that will enable additional facilities to be reached and provide for additional follow-up.	EC and U.S. EPA
Coordinate LaMP and GLBTS efforts with all related partners in order to produce a cohesive, unified program to address PCBs in the Great Lakes.	Ongoing	EC and U.S. EPA
U.S. EPA Superfund commits to completing the remedies for Springfield Township Dump (MI); G&H Landfill (MI); Metamora (MI); and Fields Brook (OH) by the end of 2002.	• Springfield Township Dump– Construction of remediation systems complete, including treatment and/or removal of 12,000 cy of sediment. Operation and maintenance is expected for the next 4 years. • G&H Landfill – Construction of onsite remedial technology (landfill cap and slurry wall) complete, wetlands restored, with groundwater extraction ongoing for at least 30 years. • Metamora – **COMPLETE** – Landfill cap constructed to contain 20,000 cy of sediment. • Fields Brook – The cleanup of Fields Brook sediment and floodplain soils is complete. 52,369 cy of sediment were removed. O&M at the on site landfill and monitoring of the brook and floodplain will continue. Remediation is also complete at the six separate source control operable units. NRDA restoration underway.	U.S. EPA

Committed Action (2000 LaMP)	**Status (2004)**	**Lead Agency**
Formalize the PCB Phasedown Program pilot project with the major utilities in the Great Lakes basin. Program is designed to encourage the utilities to phase out PCB equipment.	U.S. EPA Region 5 received comments from industry representatives on components of the PCB Phasedown Program that may improve participation in the program. The Region is evaluating changing the components to address the comments.	U.S. EPA
Identify federally owned PCBs in the Lake Erie basin and seek their removal by the departments or agencies that own the PCBs.	**Canada:** Federal PCB database complete. Database is read-only and is limited to those with an approved login account. **U.S:** As the study on the costs of the use and removal or replacement of PCB equipment continued, additional approaches to work with federal departments or agencies on removing PCB equipment they owned were pursued. U.S.EPA has begun to contact some of the owners to discuss PCB reduction challenges and requirements to register PCB transformers with U.S.EPA.	EC U.S. EPA
Organize small PCB owner workshops in the Lake Erie basin to exchange information on PCB management, decommissioning and destruction.	Information packages distributed in Sept. 2001 included PCB Owner Outreach Brochure, GLBTS-PCB Workgroup Activity Regional Update, and fact sheet on Ontario PCB In Use Inventory survey and a map showing PCB quantity and location in the Lake Erie basin.	EC and MOE
Encourage PCB owners to destroy PCBs in use or storage.	• PCB phase out commitment letters have been received from Ontario Power Generation to phase out and destroy approximately 81% of their high level PCB by 2001 and 100% by 2015. • PCB phase out commitment letter requests have been sent to the Council of Great Lakes Industry trade associations including: Aluminum Association of Canada and the Canadian Petroleum Products Institute. • A survey of over 2,000 PCB equipment owners was completed in 2002 in order to track de-commissioning progress and obtain commitments for phase-out. • A PCB Phase-Out Award program was initiated to give recognition to facilities that have conducted phase-outs. Environment Canada is also developing case studies for those that receive an award, in order to promote phase-outs and provide examples of beneficial factors considered when companies decide to remove PCBs. • Environment Canada has developed a GLBTS PCB Newsletter that will be used to promote the PCB elimination and award programs. The purpose of the newsletter is to summarize information about the GLBTS, PCBs as an environmental hazard, the Phase-Out Awards Program, and other issues in an eye-catching, simplified format.	EC
Information		
Finalize the PCB Sources and Regulations Background Report.	**COMPLETE.** The report is available at www.epa.gov/glnpo/bns/pcb/index.html	EC and U.S. EPA
Finalize the PCB Options Paper under the GLBTS that identifies options that can be undertaken to reduce PCBs in the environment.	**COMPLETE.** The report is available at www.epa.gov/glnpo/bns/pcb/index.html	EC and U.S. EPA

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
Report on an annual basis the status of sediment remediation at priority sites within the Lake Erie basin.	**COMPLETE** for priority sites within Areas of Concern see Great Lakes Binational Toxics Strategy Annual Report at www.binational.net	EC and U.S. EPA
Regulation		
	Canada: A notice with respect to PCBs in Automotive Shredder Residue was published in Gazette I on July 7, 2001 for facilities that generated residue contaminated with PCBs during 1998 – 2000. Four Environment Canada PCB regulations are being amended and targeted for Canada Gazette publication in 2004. These regulations are: 1) The Chlorobiphenyl Regulations (1977), 2) The Storage of PCB Material Regulations (1992), 3) PCB Waste Export Regulations (1996), and 4) Federal Mobile PCB Treatment and Destruction Regulations. Environment Canada is currently drafting revisions to the Chlorobiphenyl Regulations and Storage of PCB Materials Regulations under the Canadian Environmental Protection Act. The most significant revisions to the regulations will be the imposition of strict phase-out dates for certain categories of PCBs. Specifically, the following dates are proposed: • Phase-out of most high-level (>500 ppm) PCBs in-service by the end of 2007, • Phase-out of most low-level (50-500 ppm) PCBs in-service by 2014, • Phase-out of all PCBs in storage by the end of 2009 and allow in-service PCBs to be transferred to storage for one year or less, • Phase-out of most high-level and low-level PCBs from sensitive locations within three years of the proposed regulations coming into force, • Decontamination of all out-of-service liquids containing PCBs to less than 2 ppm (previously liquids and solids up to 50 ppm could be re-used, recycled, or disposed in a landfill). Revisions to the Federal Mobile PCB Treatment and Destruction regulations will see the strengthening of emissions release provisions, mainly to bring the federal regulations in line with existing provincial requirements. Extensive public consultation was conducted, and the revised regulations should be published in the Canada Gazette in early 2004. More information and updates can be found on the Environment Canada website (http://www.ec.gc.ca/pcb/). **U.S.:** In the Federal Register of July 30, 2003, a final rule was published with an effective date of September 9, 2003, that clarified how used oil that is contaminated with PCBs is regulated, as follows: • Used oil containing PCBs at concentrations of 50 ppm or greater is subject to Federal PCB regulations. Dilution may not be employed to avoid this regulation, unless otherwise specifically provided for by the RCRA or Federal PCB regulations. • Used oil containing PCBs at concentrations less that 50 ppm is subject to the RCRA used oil management standards, unless it has been diluted (from 50 ppm or greater), in which case it is treated as having 50 ppm or greater PCBs.	EC and U.S. EPA

Mercury Reduction Progress

In Canada, mercury releases have been reduced by 83 percent from the 1988 baseline. Releases in Ontario have been cut by more than 11,600 kilograms since 1988, based on Environment Canada's 2001 mercury inventory. The largest remaining sources of mercury release in Ontario are electric power generation, incineration, iron & steel production, municipal sector, and cement and lime production.

U.S. mercury emissions decreased approximately 40 percent between 1990 and 1999, according to best estimates from the National Emissions Inventory. It is likely that some additional reductions have occurred since 1999, particularly in emissions from municipal waste combustors and medical waste incinerators. Significant reductions in emissions from these sectors had already taken place by 1999, but compliance with emissions regulations for these categories was not required until after 1999. By 2006, additional regulations and

voluntary activities are expected to reduce mercury emissions a total of 50 percent or more, achieving the reduction challenge.

While U.S. mercury use declined in the late 1990s, progress since 1997 is difficult to gauge quantitatively given changes in the sources of data about mercury consumption. Available data indicate that mercury use declined more than 50 percent between 1995 and 2001; much of this decrease is attributable to decreased mercury use by the chlor-alkali industry, which accounted for an estimated 35 percent of mercury use in 1995. For a more detailed evaluation of data and assessment of progress, see http://www.epa.gov/region5/air/mercury/progress.html.

Consumer and commercial products have been significant sources of mercury. Mercury-containing products can include thermometers, switches, dental amalgams, thermostats, button batteries, and fluorescent lamps. Industrial raw materials can also contain unwanted mercury. The elimination of mercury from latex paints and batteries was a significant pollution prevention success of the manufacturing sector in the 1990s. Also, the amount of mercury contained in fluorescent lamps has been reduced.

Numerous mercury reduction activities are occurring in both Canada and the U.S. to meet the GLBTS goals regarding mercury reductions (refer to the GLBTS 2003 Progress Report, available online at www.binational.net). For example, voluntary mercury reduction agreements are being implemented with the chlor-alkali industry and hospitals. For more details and information about other reductions projects and programs check out: http://www.epa.gov/Region5/air/mercury/mercury.html.

Regulation of municipal waste, hospital waste, hazardous waste, and sludge incinerators is yielding significant reductions in air emissions of mercury. Canada-wide Standards for these sources have begun to go into effect. Canada-wide Standards have also been developed for the coal-fired Electric Power Generation sector, for mercury-containing lamps, and for dental amalgam waste. These standards are outlined at http://www.ccme.ca/initiatives/standards.html) which also provides a broader overview of the Canada-wide Standards process and implementation. In the United States, control standards for small municipal waste combustors were finalized, and compliance is already required at large municipal waste combustors, hospital incinerators, and hazardous waste combustors. Also in the United States, mercury reduction requirements have been finalized in the last two years for mercury cell chlor-alkali plants and iron foundries, and proposed for industrial boilers. Emissions from electric utility boilers, the largest source of mercury emissions in the United States, will be controlled either as a result of a control technology regulation or legislation that controls emissions of mercury along with sulfur and nitrogen. Canada-wide standards are also being developed for this sector.

In June 2001, Pollution Probe, with support from Ontario Hydro, Ontario MOE and Environment Canada, initiated a switch out program to recover mercury switches from end-of-life vehicles. In partnership with the Ontario Automotive Recycling Association the program began with 11 participating auto dismantlers across Ontario. In 2004 the program has grown to include over 130 participating dismantlers in Ontario and has been expanded to other Canadian provinces.

Current Focus of Mercury Reduction Efforts

The GLBTS Mercury Workgroup will continue to focus on information sharing about cost-effective reduction opportunities, tracking of progress toward meeting reduction goals, and publicizing voluntary achievements in mercury reduction. Particular attention will be paid to information sharing in areas where mercury releases are significant but there are no federal regulations existing or regulations are under development. For instance, the workgroup will attempt to focus attention on the contamination of metal scrap by mercury-containing devices, and the resulting emissions, and provide a forum for discussion of cost-effective approaches to address this problem. In addition, the workgroup will focus on the issue of mercury releases from dental offices and will help state, provincial and local governments identify cost-effective reduction approaches for this sector. There will also be a focused discussion of options for minimizing mercury releases resulting from the disposal of mercury-containing lamps.

Table 5.4: Mercury Reduction Plan Activities Update 2004

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
Lake Erie Basin		
Continue to implement Elemental Mercury Collection and Reclamation Program in Ohio (www.bgsu.edu/offices/envhs/environmental_health/mercury/index.htm).	Since the program began in 1998, 7200 lbs of mercury have been removed.	Ohio EPA
Establish a household hazardous waste collection facility to collect and recycle household products containing mercury in the cities of London and Waterloo, Ontario.	**COMPLETE** Fluorescent lamp collection facilities are available to households in London, Chatham-Kent, Guelph, Brantford, and Wellington County. A Mercury Thermometer Take-Back project was conducted in 2002 in the cities of London (Erie basin), Ottawa, and Thunder Bay. A total of 1.5 kg of mercury was collected.	EC
Continue P3ERIE (Pollution Prevention Partnership & Environmental Responsibility in Erie).	An additional 4,000 pounds of elemental mercury has been collected from businesses, schools, and private citizens in the greater Erie area since 2000. Well over three tons of mercury have been collected and recycled since the inception of the program. Most recently, P3ERIE has initiated a pollution prevention initiative with the PA Dental Association. www.dep.state.pa.us/dep/deputate/pollprev/P3erie/p3erie.htm	
Great Lakes Basin		
U.S. EPA (Air and Radiation Division) has committed funds to support mercury research in a number of priority areas including transport, transformation and fate, and human health and wildlife effects of methyl mercury.	This program provides more than $1 million per year for research on mercury and other air deposited pollutants in the Great Lakes Basin, focusing on persistent toxic pollutants. Since 2000, projects have been funded to better understand mercury transport, transformation and fate in the environment. Starting in 2003, ARD has (and will in the future) awarded a grant to the Great Lakes Commission to oversee the competition and selection of air deposition research proposals.	U.S. EPA
U.S. EPA filed civil complaints against seven electric utility companies operating coal-fired power plants in the Midwest and Southeast.	U.S. EPA eventually filed a total of nine cases, and has settled two of them, received favorable judgment in one, is awaiting a judge's decision in one, is in discovery on four, and received an unfavorable judgment on another.	U.S. EPA
EPA will continue to focus on research efforts and potential regulation of mercury emissions from coal-fired utilities.	On January 30, 2004, EPA published proposed regulation of the emissions from coal-fired electric utility boilers, the largest source of mercury emissions in the United States. The proposal includes two primary regulatory alternatives. The first is a control technology standard that would achieve 29 percent reduction in mercury emissions by 2009. Under this option, EPA would impose emission rate limits on individual boilers in pounds per megawatt hour of electricity generated. The other option is a two-phase "cap-and-trade" program, ultimately resulting in emissions reductions of 69 percent. This program would be implemented through state plans, under which states would receive mercury emissions "budgets" that they could meet either by setting emissions limits on individual boilers or by distributing mercury emissions allowances. These allowances could be traded with other sources across the country or banked for future use. The first phase of reductions would begin in 2010, with the final phase in 2018.	U.S. EPA

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
Michigan Department of Agriculture: Michigan Mercury Manometer Disposal grant was used to replace mercury manometer gauges used on dairy farms with non-mercury gauges. Mercury was also collected from inactive dairy farms.	**COMPLETED.** Project Period: 10/1/99 top 9/30/00.	U.S. EPA
Indiana University: Deposition of toxic organic compounds to the Great Lakes. The Integrated Atmospheric Deposition Network Grant provides funds for the operation and maintenance of the Integrated Atmospheric Deposition Network (IADN) by Indiana University.	A new cooperative agreement was awarded to IU for continuation of network through September 2004. Satellite station added at Cleveland in early 2003. New implementation plan for IADN will be signed in 2004.	U.S. EPA
The Integrated Atmospheric Deposition Network Quality Assurance and Quality Control Program Grant. The Great Lakes National Program Office (GLNPO) is collaborating with Environment Canada (EC) to implement the Binational Integrated Atmospheric Deposition Network as mandated by Annex 15 of the Great Lakes Water Quality Agreement and Section 112(m) of the Clean Air Act.	Ongoing.	U.S. EPA and EC
By the end of 2000, the U.S. EPA will work with states to develop a permitting strategy consistent with the Clean Water Act for reducing loading of mercury from industrial, municipal, and storm water sources to further the goals of the LaMP.	**COMPLETED.** Lake Erie states have developed NPDES mercury permitting strategies that incorporate method 1631 and the new GLI limits and multiple discharger variance rules.	U.S. EPA
U.S. EPA identifies point source dischargers of mercury which are monitored by NPDES permittees using the permit compliance system and shares this information with wastewater treatment plants, industry, tribes and other contributors of mercury to the extent they are relevant sources. U.S. EPA will also inform states and regulated communities about sources of unregulated pollutants of concern and share available information regarding potential substitutes and waste minimization strategies.	U.S.EPA has been using the permit compliance system in working with states on implementation of their permitting strategies and tracking mercury reduction results at permittees.	U.S. EPA
U.S. EPA Region 5 will support the rigorous development and refinement of the Regional Air Toxics Emissions Inventory of all hazardous air pollutants, including those of concern to the Great Lakes and other inland water bodies and which have a tendency to bioaccumulate. U.S. EPA will work closely with all eight Great Lakes states to assure every possible known source of all magnitudes of emissions is identified and that good emissions estimates are developed and updated to reflect the implementation of control technologies and progress in emission reductions for input to air dispersion and deposition models.	U.S. EPA has continued to support development and improvement of emissions inventories through funding for the Regional Air Pollutant Inventory Development System. The RAPIDS project had a specific task to improve the regional emissions inventory for mercury.	U.S. EPA

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
U.S. EPA commits to ensuring that all Region 5 states will have enforceable regulations and the permit applications that are required to be submitted for municipal waste combustors and for hospital/medical/ infectious waste incinerators by December 2000.	**COMPLETED.** U.S. EPA has promulgated regulations controlling emissions of mercury and other Hazardous Air Pollutants from municipal waste combustors (MWCs) and Medical Waste Incinerators (MWIs). Large MWCs needed to be in compliance by December of 2000, while small MWCs will need to comply by December of 2005, at the latest. Compliance was required at MWIs by September of 2002.	U.S. EPA
Canadian federal, provincial and territorial governments to investigate the release of mercury to the environment from various commercial products and some forms of wastes. Focus on dental amalgam, fluorescent lamps and sewage sludge. Expected to result in Canada-wide standards.	**COMPLETED**. See section 5.5 "Mercury Reduction Progress". Ontario passed Existing Hospitals Regulation (O. Reg. 323/02) requiring all existing hospital incinerators to close by Dec. 6, 2003. Ontario Regulation 196/03 came into effect Nov. 15, 2003 requiring all dental offices in which dental amalgam is placed, repaired, or removed to have a properly installed dental amalgam separator.	EC, MOE
Ontario Ministry of the Environment and EC to work with Ontario Dental Association to develop a "best management practices" document for dentists.	**COMPLETED** in 2002/03 in partnership with dental profession associations and regulatory bodies, dental collages and university and provincial and municipal governments.	MOE, EC
Information - Locally Based		
State University of New York at Buffalo: A Mercury Screening Model for Lake St. Clair: This grant supported the development of a model for the state and transport of mercury in Lake St. Clair, where mercury is a well documented problem.	**COMPLETED.** Project Period: 9/1/99 to 2/28/01.	U.S. EPA
Ohio EPA established the Ohio Mercury Reduction Group in 2001 to reduce the use, release, and emission of mercury in Ohio, to evaluate relevant departmental mercury programs and regulations, collect and assess data, promote the use of mercury alternatives and the collection of retired mercury and products, and educate industry, government and the general public on ways to reduce the sources of mercury in Ohio.	OMRG meets on a monthly basis and has produced fact sheets, an educational video, sponsored thermometer exchanges, shares the latest mercury information, and is working with U.S. EPA on their spill prevention guidance. Along with release of the guidance, OMRG will be working with U.S. EPA to educate every health department in Ohio on mercury spill and P2 information.	Ohio EPA
Information - Lake Erie Basin		
Report on an annual basis, the status of sediment remediation at priority sites within the Lake Erie basin.	See Binational Toxics Strategy Annual Report at www.binational.net	U.S. EPA and EC

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
If on-going long-range sources of mercury to the Great Lakes are confirmed, work within international frameworks to reduce releases.	In 2003, the United Nations Environment Programme (UNEP) established the new global Mercury Programme. Both Canada and the United States are participating in the Mercury Programme, which has urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases. The UNEP Mercury Programme will provide capacity building and technical assistance to help countries better characterize and address their mercury problems. The U.S. EPA and Environment Canada, with the support of the Commission for Environmental Cooperation, the International Joint Commission, and the Delta Institute, held a workshop on the long-range transport of toxic substances to the Great Lakes. The commissioned background paper, the workshop's program, the workshop presentations, and the draft summary document are available on the Internet at: http://www.delta-institute.org/lrtworkshop/open.html.	U.S. EPA and EC
Develop a pollution prevention web page at www.deq.state.mi.us/ead/p2sect/mercury and distribute mercury outreach materials to science teachers.	**COMPLETE.** The Michigan Department of Environmental Quality's (MDEQ's) environmental coordinator conducted a mass mailing of Pollution Prevention (P2) materials to all Michigan Intermediate School Districts. The "Science Teachers" and "Merc Concern" brochures were featured, along with a new publication titled "The P2 Education Tool Box".	Michigan and U.S. EPA
Lake Erie Public Forum targeted fish advisory materials and website in cooperation with the Lake Erie Binational Public Forum.	The Lake Erie Public Forum created easy to read and culturally sensitive fish advisory brochures to reach at risk populations. They were distributed at events likely to be frequented by minorities or lower income target populations. Information is also available on the Lake Erie Forum website, maintained by the Delta Institute, at www.erieforum.org/fishguide/fishguide.php. This project is ongoing.	Lake Erie Forum
EPA Superfund commits to completing maps including data on location of sensitive species, tribal lands, natural areas, managed lands, economic resources and potential spill sources and providing these maps to LaMP/RAP partners by the end of FY 2002.	Maps were completed for western Lake Erie and the Cleveland area. They are part of the Inland Area Sensitivity Atlas prepared as required under the Oil Pollution Act of 1990. See www.umesc.usgs.gov/epa_atlas/overview.html	U.S. EPA
Promote the Great Art for Great Lakes Virtual Classroom, with its mercury millennium theme, in primary schools in the Lake Erie basin.	**COMPLETE**	
Promote to school boards in the Lake Erie basin a mercury stewardship school curriculum program.	Project materials and workshops were delivered in over 20 schools across the Thames Valley District School Board and London District Catholic School Board.	EC
Information - Great Lakes Basin		
Ohio 's Office of Pollution Prevention will produce two fact sheets that focus on ways to reduce mercury and other PBTs.	Ohio EPA has produced 4 mercury fact sheets, a mercury web page and a mercury educational video. www.epa.state.oh.us/opp/mercury_pbt/mercury.html	Ohio EPA
U.S. Navy, Great Lakes Naval Station, Naval Dental Research Institute: Mercury Removal from the Dental-Unit Waste Stream – The interagency agreement provides funds to the Naval Dental Research Institute to examine the mercury removal from dental unit wastewater stream. Project Period: 9/1/99 to 8/31/00.	**COMPLETE.** The Great Lakes Naval Dental Research Institute continues to pursue this research with funding from U.S. EPA's Great Lakes National Program Office.	U.S. EPA

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
The Delta Institute Sector Based Pollution Prevention – The Delta Institute will focus on achieving reductions through commitments from the private and public sector owned and operated energy production units. Project Period: 10/1/99 to 9/30/00.	In July of 1999, the Delta Institute launched a partnership with the Council of Industrial Boiler Owners to achieve emission reductions of GLBTS Level I and Level II pollutants from industrial boilers through the implementation of selected energy efficiency technologies and methods. Delta undertook a study that found that a 10% improvement in energy efficiency to the 1531 coal burning industrial boilers and 1436 residual fuel oil burning boilers in the Great Lakes basin would result in a mercury emissions reductions of 443 lbs and 389 lbs respectively. Delta and CIBO are working with EPA, MDEQ and Ohio EPA to launch a national energy efficiency campaign for industrial boilers. More information can be found at http://delta-institute.org/pollprev/ibp.php	U.S. EPA
National Wildlife Federation: Local and sector based Pollution Prevention in the Binational Strategy – The National Wildlife Federation will focus on 1) building one existing efforts to implement pollution prevention, by way of sector-based strategies; and 2) coordinated environmental non-governmental organization participation in the Binational Toxics Strategy. Project Period: 10/1/99 to 9/30/00.	**COMPLETE.** NWF continues to participate in the GLBTS and pursue this work.	U.S. EPA
Ohio Healthy Hospital Pollution Prevention Initiative	A formal agreement was signed between Ohio EPA and the Ohio Hospitals Association in 1999 to develop and implement a strategy to virtually eliminate and OHA mercury and mercury-containing waste from the health care industry's waste stream by 2005. A mercury challenge handbook has been prepared as well as a web page and the program continues. See: www.epa.state.oh.us/opp/hospital.html	Ohio EPA
U.S. EPA will assist utilities in developing mercury control technology. Assistance may may not take the form of funding.	U.S. EPA and the Department of Energy have participated in several projects to develop "clean coal" technology.	U.S. EPA
Agencies will work with communities to provide sector-specific pollution prevention outreach such as workshops for the medical and dental communities, and other important sectors.	**Canada:** Online pollution prevention information to assist health care professionals is available at www.c2p2online.com Seminars on environmental programs, products and services were held during the Ontario Hospital Assoc. convention November 2002. Mercury thermometer take-back programs held at hospitals associated with the Cdn Coalition for Green Health Care. Green Healthcare workshop held in September 2003. **U.S.:** Chlor-alkali industry, through the Chlorine Institute, committed in 1996 to reduce mercury use 50 percent by 2005. The industry reported in April 2003 that they achieved 50% reduction in mercury use between 1995 and 2002. The American Hospital Association and U.S. EPA through the Hospitals for a Healthy Environment (H2E) program have produced a Mercury Virtual Elimination Plan for U.S. hospitals. In addition, workgroups are implementing work plans on various aspects of hospital waste reduction. U.S. EPA and Environment Canada held a workshop on dental mercury reductions for state and local governments in December of 2002. A report was produced, based on this workshop.	EC U.S.EPA

Committed Action (2000 LaMP)	Status (2004)	Lead Agency
U.S. EPA will encourage proper management of dental wastes that contain mercury.	U.S. EPA continues to fund dental mercury waste projects through the GLNPO Pollution Prevention and Toxics Reduction grant program and Regional PPIS grants. A grant was awarded to Erie County (NY) in 2003. A grant was awarded to Delta Institute to work with the cities of Solon and Elyria (OH) to reduce the input of mercury from medical and dental sectors into the waste stream of wastewater treatment plants. The project is ongoing.	U.S.EPA
U.S. EPA will track the disposition and of the U.S. Federal Government's mercury stockpiles.	**COMPLETE.** U.S. EPA has tracked the Defense Logistics Agency's development of an Environmental Impact Statement on the mercury stockpiles, which has been released in draft form. DLA has proposed a preferred option of long-term storage of the stockpile.	U.S.EPA
Agencies will assist schools in seeking out and disposing of mercury on school property.	The Michigan Department of Environmental Quality's (MDEQ's) environmental coordinator conducted a mass mailing of Pollution Prevention (P2) materials to all Michigan Intermediate School Districts. The "Science Teachers' and "Merc Concern" brochures were featured, along with a new publication titled "The P2 Education Tool Box".	U.S.EPA and Michigan
The Great Lakes Binational Toxics Strategy should be pursued to meet the short term, interim goals (e.g., 50% reduction in mercury U.S. sources and emissions by 2006 and for Canada, a 90% reduction in the release of mercury from polluting sources by 2000).	See Section 5.5 portion titled "Mercury Reduction Progress" and "Current Focus of Mercury Reduction Efforts."	U.S.EPA and EC
Sampling will begin in 2000 for the National Study of Chemical residues in lake fish tissue, a new effort to develop a national picture of the distribution of a variety of potential fish contaminants in the Nation's lakes. Bioaccumulative organic chemicals and mercury will be analyzed.	Sampling has been completed and a final report is due out by the end of FY2004.	U.S.EPA Region 5
U.S. EPA will complete the pilot projects to establish TMDL allocations for two waterbodies receiving mercury from atmospheric deposition in order to evaluate the integration of air and water program technical tools and authorities and to examine emission reduction options.	U.S. EPA Headquarters is currently reviewing a proposal from the ECOS Quicksilver Workgroup on developing alternatives to TMDLs for mercury. Once the proposal is finalized, Region 5 will be working with states to develop either this alternative or to develop TMDLs.	U.S.EPA Region 5

5.6 Emerging Chemicals

The LaMP has recognized that emerging chemicals may impact on the LaMP's vision of a sustainable Lake Erie ecosystem and that a process is needed to evaluate the potential impacts, sources, and remediation options for emerging chemicals. The LaMP will be looking to the Great Lakes Binational Toxics Strategy, as the experts in persistent toxic substance reduction, to identify potential emerging chemicals of concern in the Great Lakes. The Great Lakes Binational Toxics Strategy has committed to developing an *Emerging Pollutants Evaluation Protocol* to evaluate the impacts of specific emerging pollutants in the Great Lakes.

The LaMP's Sources and Loads Subcommittee anticipates updating the list of critical pollutants and pollutants of concern over the next two to three years. A review of the beneficial use impairments (BUIs), together with information about the potential causes

of those BUIs, will be used to assess whether changes in status of the existing pollutants of concern and/or critical pollutants are warranted, or whether new compounds should be elected to these lists.

5.7 Future Directions

The binational sediment mapping of critical pollutants and pollutants of concern has been completed (see Section 5.2). A report is in preparation by the U.S. Geological Survey (USGS) outlining the methodology and results of the sediment mapping initiative, including an overview of contaminated sites in the basin, an assessment of spatial trends, and recommendations for future directions in the management of contaminated sediments. The report will also include a summary of the findings of the sediment workshop held in 2002 in which experts from across the basin met to discuss the status of sediment contamination, assessment and remediation projects in the Lake Erie basin.

Through the United States Geological Survey, the Sources and Loads Subcommittee is also currently undertaking a basin-wide initiative to map fish tissue contaminant data, similar to the sediment mapping effort. Fish species that migrate over relatively small areas are being selected so that spatial trends can be assessed in a meaningful way across the Lake Erie basin. Possible relationships in the spatial trends between the fish tissue and sediment quality data will be examined. Differences between the different agencies' fish collection procedures and analytical methods may make some data comparison difficult, but it is anticipated that this information compilation will result in a unique, basin-wide view of the status of fish contamination. A report of this initiative is anticipated during 2004.

In addition to providing technical reports of the results of the mapping initiatives, we anticipate some more informal reporting to the Remedial Action Plans (RAPs) to proceed during 2004. The RAPs may be interested to know how the contaminant status within their particular area of concern (AOC) compares with other AOCs. As a communication tool, the Sources and Loads Subcommittee will also be calculating a Sediment Quality Index (SQI) for the sediment quality data across the basin. The SQI compares the sediment quality data to existing environmental guidelines, and is used to calculate an overall index that rates the sediment quality as excellent, very good, good, fair or poor. In this way, the overall sediment quality can be viewed in a nutshell, across the basin, without having to assess information from the maps of the sediment quality compounds individually.

An analysis of source information in the basin will form the next priority for this Subcommittee. Both the U.S. and Canadian environmental agencies compile and maintain information about discharges of contaminants to the environment. The available information will be compiled on a binational basis and compared with the environmental quality information already examined in order to assess if monitoring gaps exist (e.g., sources with no nearby monitoring data) or if there are sites of unexplained environmental quality (e.g., hot spots with no known sources). The Subcommittee is also aligning itself to better coordinate with the Great Lakes Binational Toxics Strategy (GLBTS) in order to follow up on source reduction activities and remediation activities.

5.7.1 Evaluation of Pollutant Release Inventories and Permit Systems

Over the next year, the Lake Erie LaMP Source and Loads Subcommittee will be evaluating national datasets that provide estimated and measured releases of critical and priority pollutants within the Lake Erie Basin. The Toxic Release Inventory (TRI) and the Permit Compliance System (PCS) will be evaluated in the United States, while the National Pollutant Release Inventory (NPRI) and Ontario's Municipal/Industrial Strategy for Abatement (MISA) will be evaluated in Canada.

Although useful in many ways, the TRI and NPRI have various limitations and do not capture data for all substance releases into the basin. In particular, the criterion for reporting to these programs is such that numerous smaller sources are not captured. Also, reported releases are not always measured, but may in fact be estimates. Reporting criteria have evolved over the years, requiring new sectors to report; substances have been added or

reporting thresholds for existing substances have changed. These ongoing changes make it more difficult to interpret the overall database through time. The data that is of greatest value to the Lake Erie LaMP are the on-site releases to air, water, and land, as well as off-site transfers of substances to sewage treatment plants. Releases to land include those contaminants disposed on-site to sanitary or hazardous waste landfills, as well as land surface applications and holding pits. Releases reported within the Lake Erie Basin do not necessarily imply that they are directly discharged to Lake Erie, nor that these contaminants are physically or biologically available to biota within the Basin; however, it is an adequate representation of sources and releases of available or potentially available contaminants.

Figures 5.11 and 5.12 show the top 10 contributing industries for releases of mercury and mercury compounds to land (including on-site landfills), off-site transfers to sewage treatment plants, and releases to air and water, respectively, over an eight year period (1995-2003) within the Lake Erie Basin. During that period, over 69,000 kg (151,800 lbs) of mercury were reported released or transferred to the basin: approximately 29,200 kg (64,000 lbs) to sewage treatment; 19,900 kg (43,780 lbs) to air, 20,000 kg (44,000 lbs) to land, and 168 kg (370 lbs) directly to water. Companies certified to deal with sanitary and hazardous waste were the top contributors followed by electric generating plants and chlor-alkali plants. Other contributors were manufacturers of industrial chemicals, paper, steel, mineral products, electric lamps, hoses and belts, and cement.

Figures 5.13 and 5.14 show the top contributors of PCBs to the environment as reported by TRI over the same eight year period. The NPRI program in Canada does not require reporting for the release of PCBs. Over 758,000 kg (1.7 million lbs) of PCBs were disposed of at on-site hazardous waste landfills and storage facilities within the Basin, representing 99% of the total PCBs released. Five kg (11 lbs) were released to sewage treatment, and 310 kg (680 lbs) were released to the air. No PCBs were reported discharged directly to water. As was the case for mercury, waste management companies were the top contributors as a secondary handler of PCBs transferred from other facilities for the purpose of treatment/ disposal. Manufacturers of abrasive products were the greatest contributor of PCBs to the air with 160 kg (352 lbs).

A detailed summary of the bed-sediment, related fish tissue and industrial emissions data analyzed for use in the LaMP 2006 report will be published by USGS in 2007.

Figure 5.11: Mercury and its compounds - Top 10 industries reporting onsite releases to land and transfers to sewage treatment plants within the Lake Erie Basin. (Toxic Release Inventory (TRI) and National Pollutant Release Inventory (NPRI), 1995-2003)

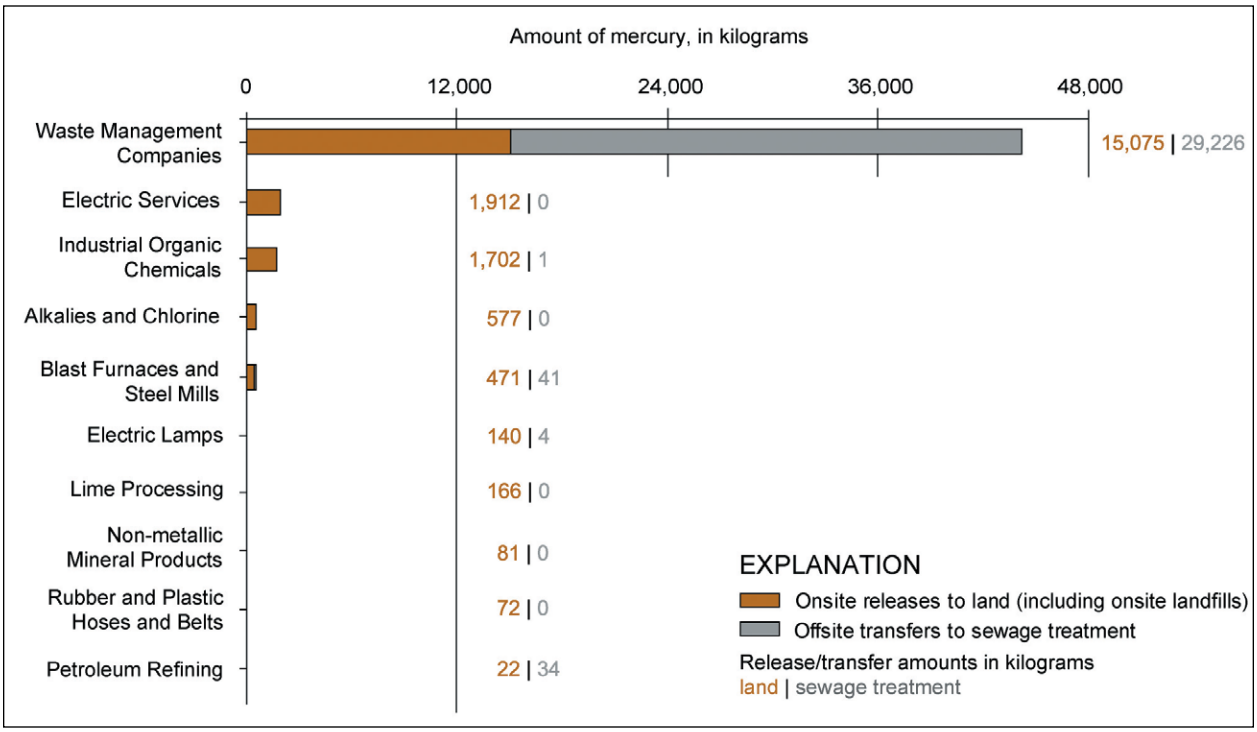


Figure 5.12: Combined estimated mercury onsite releases to air and water within the Lake Erie Basin for the top 10 contributing U.S. and Canadian industries. (Toxic Release Inventory (TRI) and National Pollutant Release Inventory (NPRI), 1995-2003)

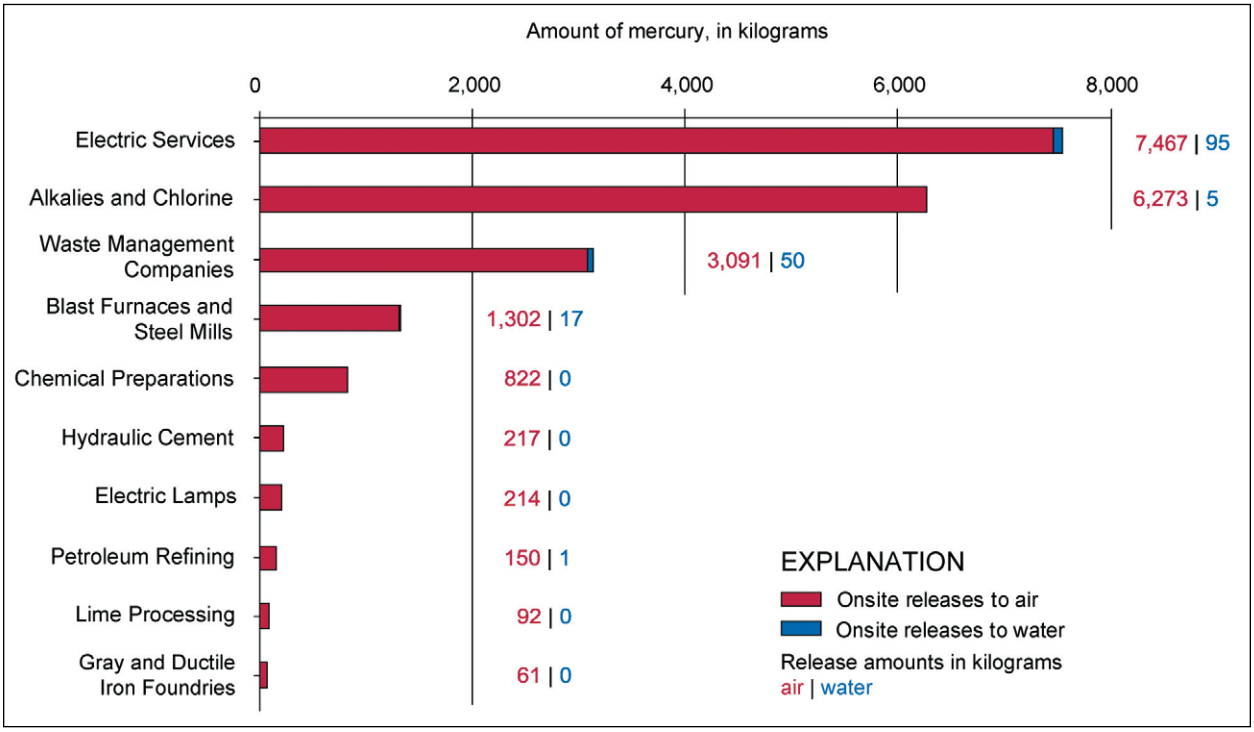


Figure 5.13: Polychlorinated biphenyls (PCBs) - Industries reporting onsite releases to land and tranfers to sewage treatment plants within the Lake Erie Basin. (Toxic Release Inventory (TRI), 1995-2003)

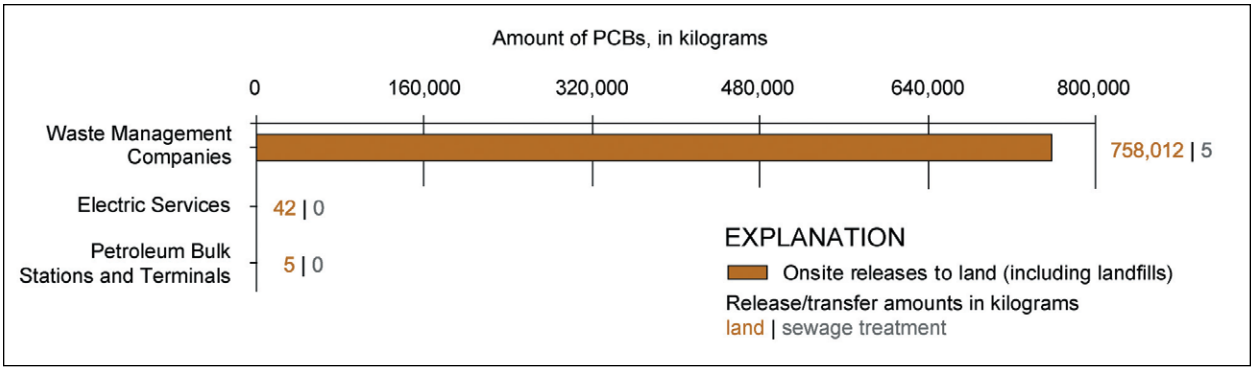
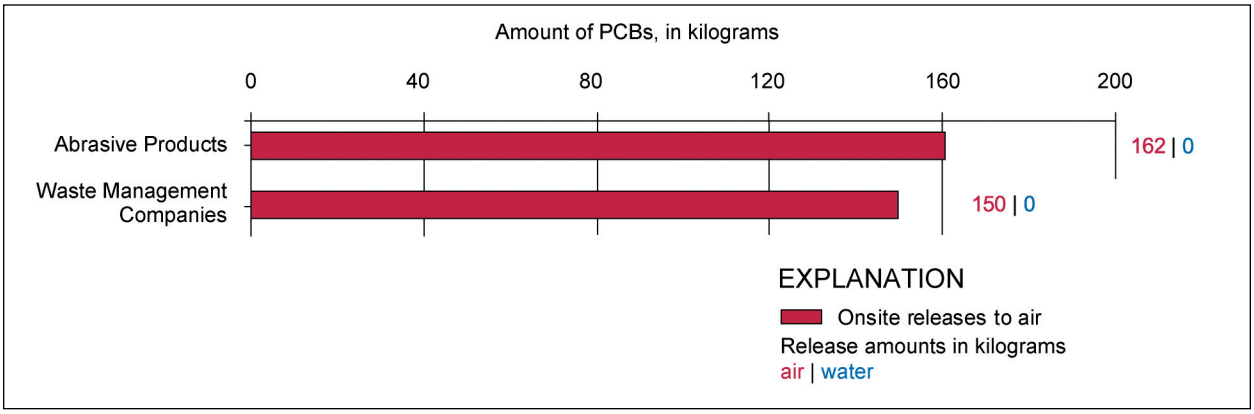


Figure 5.14: Polychlorinated biphenyls (PCBs) - Industries reporting onsite releases to air and water within the Lake Erie Basin. (Toxic Release Inventory (TRI), 1995-2003)



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